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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

ED 061302

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

CRUSHER INSPECTOR (IRON & STEEL) 631.381
MILL-END INSPECTOR (IRON & STEEL) 619.381
MILL INSPECTOR (IRON & STEEL) 619.381
PIPE & COUPLING SIZER (IRON & STEEL) 619.381
PIPE WALKER (IRON & STEEL) 619.381
THREAD INSPECTOR (IRON & STEEL) 619.687

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February 1957

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STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR CRUSHER INSPECTOR (IRON & STEEL) 631.381-065 MILL-END INSPECTOR (IRON & STEEL) 619.381-022 MILL INSPECTOR (IRON & STEEL) 619.381-026 PIPE & COUPLING SIZER (IRON & STEEL) 619.381-030 PIPE WALKER (IRON & STEEL) 619.381-034 THREAD INSPECTOR (IRON & STEEL) 619.687-010

S-97

Summary

The General Aptitude Test Battery, B-1001, was administered during the period December 1952 to August 1954 to 70 applicants subsequently employed as inspectors in the Metallurgical Department of the Lone Star Steel Company, Lone Star, Texas. All 70 workers were included in the final experimental sample. The criterion consisted of pooled ratings expressed in three broad categories. On the basis of the statistical and qualitative analysis of the data, Aptitudes G-Intelligence, N-Numerical Aptitude, S-Spatial Aptitude and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Crusher Inspector 631.381, Mill-End Inspector 619.381, Mill Inspector 619.381, Pipe & Coupling Sizer 619.381, Pipe Walker 619.381, and Thread Inspector 619.687 S-97

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Crusher Inspector 631.381, Mill-End Inspector 619.381, Mill Inspector 619.381, Pipe & Coupling Sizer 619.381, Pipe Walker 619.381, and Thread Inspector 619.687.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for S-97

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	80	G	Part 3 Part 4 Part 6	75
N	CB-1-D CB-1-I	80	N	Part 2 Part 6	75
S	CB-1-H CB-1-F	90	S	Part 3	85
M	CB-1-M CB-1-N	80	M	Part 9 Part 10	80

Effectiveness of Norms

The data in Table V indicate that 15 of the 18 poor workers, or 83 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 83 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 48 of the 51 workers who made qualifying test scores, or 94 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupations of Crusher Inspector 631.381, Mill-End Inspector 619.381 Mill Inspector 619.381 Pipe & Coupling Sizer 619.381 Pipe Walker 619.381 and Thread Inspector 619.687.

II. Sample

The General Aptitude Test Battery, B-1001, was administered during the period December 1952 to August 1954 to 70 applicants who were subsequently employed as inspectors in the Metallurgical Department of the Lone Star Steel Company, Lone Star, Texas. The test results were not used in the selection of these workers nor in their assignment as inspectors in the Inspectional Division. All of the 70 workers tested were included in the final experimental sample.

On-the-job training of the inspectors was conducted by experienced steel-worker foremen.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for Age, Education, and Experience

Crusher Inspector (IRON & STEEL) 631.381
Mill-End Inspector (IRON & STEEL) 619.381
Mill Inspector (IRON & STEEL) 619.381
Pipe & Coupling Sizer (IRON & STEEL) 619.381
Pipe Walker (IRON & STEEL) 619.381
Thread Inspector (IRON & STEEL) 619.687

N = 70

	M	σ	Range	$_{c}r$
Age (years)	29.2	8.6	18 - 52	-.150
Education (years)	12.1	2.4	6 - 17	.248*
Experience (months)	11.1	1.3	8 - 15	-.033

* Significant at the .05 level

The correlation between education and the criterion is significant at the .05 level, indicating that the better educated individuals tend to be better workers and/or that the supervisors providing the criterion ratings tended to be biased in favor of the better educated workers. The data in Table II indicate that this sample is suitable for test development purposes with respect to age, education and experience.

III. Job Descriptions

Job Titles: Crusher Inspector (IRON+STEEL) 6 31.381
Mill-End Inspector (IRON+STEEL) 6 19.381
Mill Inspector (IRON+STEEL) 6 19.381
Pipe & Coupling Sizer (IRON+STEEL) 6 19.381
Pipe Walker (IRON+STEEL) 6 19.381
Thread Inspector (IRON+STEEL) 6 19.689

NOTE: Production of high-pressure pipe begins at the weld machine where rolls of sheet metal called skelp are cut in lengths, rolled into tubes, and machine welded into varying lengths of pipe. It is then mechanically conveyed to the normalizing equipment where stress is relieved through heat. The pipe is then cooled, sized to diameter, and conveyed to mill tables where each length is inspected by a Mill Inspector
There are approximately 200 lengths of pipe in process between the weld machine and the mill tables. Pipe then flows to the cut-off machines where the crop ends are cut off. The crop ends are then inspected by the Crusher Inspector 6-88.807. Pipe is then threaded and conveyed to a table where one end is inspected by a Thread Inspector 6-88.808, and the other end by a Mill-End Inspector 6-88.808. The pipe is then conveyed to the hydrostatic testing machine and while under pressure of 4400 pounds per square inch is inspected by the Pipe Walker 6-88.804. The pipe leaves the hydrostatic testing machine and is then inspected by a Mill-End Inspector 6-88.808. Pipe couplings are inspected by a Pipe and Coupling Sizer 6-88.801 at an inspection point removed from the direct line of pipe production. Pipe or couplings may be rejected at any one of the inspection points.

Crusher Inspector
Job Summary: Operates crusher to test strength and inspect quality of weld on crop ends of pipe: Places the short length, or crop-end cut from pipe into crusher. Presses foot bar to actuate crusher which steadily flattens crop end until weld seam breaks. Observes process to see that crop end is flattened beyond a specified point (indicated by a flashing light signal) before weld seam breaks. Stops crusher, removes crop end and inspects weld break to determine quality of weld according to characteristic appearance of break. Marks defects on all pipe scrapped because of failure to pass crush test. Prepares daily report classifying defects found on pipe failing test.

Mill-End Inspector
Job Summary: Inspects threads on one end of pipe, screws coupling to hand-tight position and checks for stand-off: Inspects threads visually for such defects as burrs and battered or damaged threads. Brushes thread compound on threads of pipe and screws coupling to hand-tight position with coupling wrench. Checks for stand-off by observing that hand-tightened coupling stands off three turns from its final power-tight position on the pipe. May be assigned to visual inspection of pipe after it has been hydrostatically tested and the coupling power tightened. Checks for possible damage resulting from this process.

Mill Inspector
Job Summary: Inspects pipe visually, inside and out, and marks pipe for further processing: Views inside of pipe with a id of spotlight to inspect surface for projections and visible weld defects. Rolls pipe back and forth on mill table to see that warpage is less than 1/4 inch in full length of pipe. Visually inspects outside surface of pipe for pits and estimates depth of pits in terms of the tolerance standards. Measures with depth gauge those pits suspected of being close to the maximum depth tolerance of .030 of an inch. Inspects outside weld joint for visible defects such as overlap, pits and open seams. May further check weld by tapping pipe with a hammer and listening for a dull sound which denotes some internal defect of the weld. Marks the weld joint with chalk for pipe walker and crop ends for cutter operator. Checks outside diameter of an occasional pipe with go-no-go gauge set for .020 inch tolerance. May measure exact diameter of pipe with micrometer to facilitate control of diameter sizing equipment. Reports to welder all forming and welding defects. Prepares daily report on pipe inspected.

Pipe & Coupling Sizer
Job Summary: Inspects couplings for correct stand-off with plug gauge: Brushes oil on threads. Screws coupling on plug gauge to hand-tight position with couplings wrench and checks stand-off. Removes and reverses coupling to check stand-off on opposite end. Marks stand-off on both ends of coupling. Marks and disposes of defective couplings. Checks plug gauge with size ring periodically.

Pipe Walker
Job Summary: Inspects for leaks while pipe is being hydrostatically tested: Watches weld seam to spot leaks while pipe is mechanically vibrated and subjected to internal water pressure of approximately 4400 pounds per square inch. Observes pressure gauge and employs stop watch to verify that required pressure is maintained for the specified five seconds. Marks defective areas on pipe with chalk. Marks pipe which can be salvaged. Prepares daily report on pipe inspected.

TABLE III

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_c r$) for the Aptitudes of the GATB

Crusher Inspector (IRON + STEEL) 631.381
Mill-End Inspector (IRON + STEEL) 619.381
Mill Inspector (IRON + STEEL) 619.381
Pipe & Coupling Sizer (IRON + STEEL) 619.381
Pipe Walker (IRON + STEEL) 619.381
Thread Inspector (IRON + STEEL) 619.687

N = 70

Aptitudes	M	σ	$_c r$
G-Intelligence	103.5	20.0	.435**
V-Verbal Aptitude	92.3	16.9	.302*
N-Numerical Aptitude	101.7	18.6	.417**
S-Spatial Aptitude	109.0	19.1	.421**
P-Form Perception	96.8	15.5	.314**
Q-Clerical Perception	85.2	14.4	.271*
A-Aiming	84.0	19.6	.211
T-Motor Speed	83.2	18.2	.163
F-Finger Dexterity	98.6	19.9	.231
M-Manual Dexterity	99.7	19.3	.287*

** Significant at the .01 level
* Significant at the .05 level

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Form Perception (P) - required to inspect pipe visually for defects and to determine whether defects are within acceptable tolerances.

Finger Dexterity (F) and Manual Dexterity (M) - required to manipulate pipe, guages, and other materials.

The highest mean scores, in descending order of magnitude, were obtained for Aptitudes S, G, N and M, respectively. All of the aptitudes, except Aptitude G have standard deviations of less than 20. Aptitude Q has the lowest standard deviation. Aptitudes G, N, S and P correlate significantly with the criterion at the .01 level. Aptitudes V, Q and M correlate significantly with the criterion at the .05 level.

TABLE III

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_cr$) for the Aptitudes of the GATB

Crusher Inspector (IRON + STEEL) 619.381
Mill-End Inspector (IRON + STEEL) 619.381
Mill Inspector (IRON + STEEL) 619.381
Pipe & Coupling Sizer (IRON + STEEL) 619.381
Pipe Walker (IRON + STEEL) 619.381
Thread Inspector (IRON + STEEL) 619.687

N = 70

Aptitudes	M	σ	$_cr$
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P-Form Perception	96.8	15.5	.314**
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A-Aiming	84.0	19.6	.211
T-Motor Speed	83.2	18.2	.163
F-Finger Dexterity	98.6	19.9	.231
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The highest mean scores, in descending order of magnitude, were obtained for Aptitudes S, G, N and M, respectively. All of the aptitudes, except Aptitude G have standard deviations of less than 20. Aptitude Q has the lowest standard deviation. Aptitudes G, N, S and P correlate significantly with the criterion at the .01 level. Aptitudes V, Q and M correlate significantly with the criterion at the .05 level.

On the basis of the qualitative and quantitative evidence cited above, Aptitudes G, N, S, P and M were considered further for inclusion in the test norms. Aptitudes G, N, S and M were selected for further consideration because they all had relatively high means and significant correlations with the criterion. In addition, Aptitude M appeared important on the basis of the qualitative analysis of the job. Aptitude P was also selected for further consideration because this aptitude had a significant correlation with the criterion and appeared important from the qualitative analysis of the job. Aptitudes V and Q have significant correlations with the criterion, but these aptitudes did not have high mean scores and they did not appear important from the qualitative analysis of the job. Aptitude F appeared important on the basis of the qualitative analysis but there was no quantitative evidence for this aptitude. There was no evidence, qualitative or quantitative, for Aptitudes A and T. Therefore, Aptitudes V, Q, A, T and F were not given further consideration for inclusion in the norms.

Various combinations of Aptitudes G, N, S, P and M with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the dichotomized criterion was determined, using the tetrachoric correlation technique. A comparison of results showed that norms consisting of G-80, N-80, S-90 and M-80 had better selective efficiency than any other set of norms tried. The cutting score for each of the aptitudes in the norms was set at a point one standard deviation below the aptitude mean and rounded to an adjacent five-point score level. Setting cutting scores at these levels yielded the best selectivity for the norms.

VII. Predictive Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized with those workers rated as Above Average and Average placed in the high criterion group, and with those rated as Below Average placed in the low criterion group. Table IV shows the relationship between test norms consisting of G-80, N-80, S-90 and M-80 and the dichotomized criterion for the sample of pipe inspectors. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group have been designated as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes G, N, S, and M with Critical Scores of 80, 80, 90 & 80, Respectively, and the Criterion for

Crusher Inspector (IRON + STEEL) 631.381
Mill-End Inspector (IRON + STEEL) 619.381
Mill Inspector (IRON + STEEL) 619.381
Pipe & Coupling Sizer (IRON + STEEL) 619.381
Pipe Walker (IRON + STEEL) 619.381
Thread Inspector (IRON + STEEL) 619.687

N = 70

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	4	48	52
Poor Workers	15	3	18
Total	19	51	70

$r_{tet} = .94$ $\quad X^2 = 34.957$

$\sigma_{r_{tet}} = .22$ $\quad P/2 < .0005$

The data in the above table indicate a high and significant relationship between the test norms and the criterion for this sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes G, N, S and M with minimum scores of 80, 80, 90 and 80, respectively, are recommended as B-1001 norms for the occupations of Crusher Inspector 631.381, Mill-End Inspector 619.381, Mill Inspector 619.381, Pipe & Coupling Sizer 619.381, Pipe Walker 619.381, and Thread Inspector 619.687. The equivalent B-1002 norms consist of G-75, N-75, S-85 and M-80.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include four aptitudes, only those occupational aptitude patterns which include three of those four aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. Two of the existing 22 occupational aptitude patterns meet these criteria for

this study. These occupational aptitude patterns and their B-1001 norms are OAP-11 (N-85, S-95, M-80) and OAP-19 (G-85, N-80, M-90). The selective efficiency of each of these OAP's for this sample was determined by means of the tetrachoric correlation technique. A significant relationship was obtained between each of the two OAP's and the dichotomized criterion and each OAP screened out a proportion of the sample that was within the required range of .10 and .60. However, the highest tetrachoric correlation, .83, with a standard error of .21, was obtained for OAP-11. The proportion of the sample screened out by OAP-11 was .37. Therefore, it is recommended that OAP-11 be used in counseling for the occupations of Crusher Inspector 631.381, Mill-End Inspector 619.381, Mill Inspector 619.381, Pipe & Coupling Sizer 619.381, Pipe Walker 619.381, and Thread Inspector 619.687